

papers that followed on the same topic, and therefore we comment only on what we read. Language is extremely important in communicating scientific findings to peers and, more importantly, to the public. Thus, it is important to be as precise as possible. The public, in turn, must weigh a given risk against other risks they are willing to assume on a daily basis (eg, driving a car, smoking cigarettes, eating French fries or not exercising), and this "risk mix" ultimately will influence individual risk perception and behaviour. It is our opinion that in many instances concerning the female athlete triad, the data do not match the sensational language often used to warn young girls and women of "the risks associated with exercise". Further, although the social marketing value of the catchphrase "female athlete triad" is high, it connotes something bigger than what can actually be measured properly, and, frankly, is insulting to most women athletes who train and compete hard, bear children, and continue towards a healthy and successful older age. Indeed, if undernutrition (ie, low energy availability) in sports is the primary issue at hand, then any position stand and subsequent papers to this effect should be titled as such, and should be directed towards health consequences for male and female athletes. Finally, a position stand from the American College of Sports Medicine or any other organisation attempting to influence practice and policy should be evidence based and should rely on the highest quality data and not primarily on those generated from consensus or from the same group of researchers.

We remain grateful for the opportunities to state our opposing views on the female athlete triad. Such opportunities have allowed us to confront several difficult issues that are socio-political as well as scientific. As scientists, we should (with respect) agree to disagree on the specific areas of contention concerning the triad and trust that individuals will make informed choices about their own behaviour based on the best available knowledge.

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doi: 10.1136/bjism.2006.032854

The original article is as follows:

DiPietro L, Stachenfeld NS. The myth of the female athlete triad. *Br J Sports Med* 2006;**40**:490–3.

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## Correction of misinterpretations and misrepresentations of the female athlete triad

The recent commentary by DiPietro and Stachenfeld<sup>1</sup> is of great concern because it lacks scientific accuracy in the interpretation of data regarding the female athlete triad and promotes an unfounded fear that triad-related data will discourage girls and women from participating in sports.

DiPietro and Stachenfeld state that they wish to "share comments and opinions which challenge many of the causal assumptions proposed in the current literature on this topic". They first attack the triad from a sociological perspective, warning readers that decades of progress of women in sports is at risk owing to "the creation of yet another form of female specific pathology". They are concerned that "Triad related data may be misinterpreted and used as justification for setting health and social policies that may ultimately counter the US Public Health Service efforts to promote the benefits of athletic participation and an active lifestyle among children and adolescents". Using this logic, researchers and health professionals should abandon their efforts to understand and prevent anterior cruciate ligament injuries in women, which occur at a rate of 6–8 times that in men,<sup>2</sup> for fear that attention to this "female specific pathology" would discourage participation in sports. Interestingly, although over one hundred studies document the existence of menstrual disturbances, disordered eating and low bone mass in exercising women,<sup>3,4</sup> DiPietro and Stachenfeld do not offer a single data point in support of their "opinion" that education about the triad might discourage the participation of girls and women in physical activity. In fact, actual data suggest the opposite. The National Federation of State High Schools Associations (NFHS) *High School Athletics Participation Survey*<sup>5</sup> reports that the number of girls participating in high school sports set an all-time record in 2004–5, soaring to 2 908 390 participants and representing a 13% increase compared with the 1997–8 rates. Data from the US National Collegiate Athletic Association (NCAA) *Sports Sponsorship and Participation Rates Report*<sup>6</sup> also present similarly increasing numbers of women participating in NCAA sports at the collegiate level. Comparisons of 1997–8 participation rates with the 2004–5 rates show a 51% increase in women's participation at the collegiate level.<sup>6</sup> Thus, participation rates of girls and women at the high school and collegiate levels have continued to rise since the 1997 publication of the triad, and these numbers exceed the increases in participation rates observed in boys and men's sports at both

the high school (9%) and collegiate (9%) levels.<sup>5,6</sup> Consequently, the Fédération Internationale de Football Association (FIFA) estimates that worldwide, by 2010 more women than men will be playing football.<sup>7</sup>

Therefore, we challenge DiPietro and Stachenfeld to support their "opinion" by designing, executing and publishing in a peer reviewed journal a prospective randomised trial to directly test their hypothesis that educating the public about the possible unhealthy effects of the triad discourages participation in sports. They might also assess how many wrestlers discontinued their sport when, upon the publication of an American College of Sports Medicine (ACSM) position stand on unhealthy weight loss practices in wrestling,<sup>8</sup> new rules regarding body weight management in collegiate wrestling were implemented by the NCAA. They might also assess how many people did not take up or abandoned an exercise routine after another ACSM position stand<sup>9</sup> warned of the dangers of dehydration and running in the heat. Meanwhile, as we wait for these important datasets, it is likely that the benefits of education and policy about the health hazards of the triad will increase the numbers of girls and women who can maintain a healthy and active lifestyle over their lifespan because they were warned about the triad in time to prevent injuries, decrements in performance and loss of bone mass—just as objective evidence has shown that the NCAA weight management programme has been effective in reducing the practice of unhealthy weight loss behaviours among wrestlers.<sup>10</sup>

DiPietro and Stachenfeld define the triad as "a syndrome consisting of three necessary components: (a) disordered eating; (b) amenorrhea; (c) osteoporosis". This statement is factually incorrect. In the ACSM 1997 position stand,<sup>11</sup> the triad is defined as the "existence of one or more components of the Female Athlete triad, alone or combination, that pose significant health risks to physically active athletic girls and women". Thus, the simultaneous existence of all three components is not necessary to confirm the existence of the triad. The use of the term triad derives from the strong inter-relationships among its components.<sup>3</sup> For example, inadequate caloric intake relative to exercise energy expenditure can lead to suppressed reproductive function, but it may not be associated with low bone density if an individual has not been amenorrhoeic for sufficient duration, or if he or she possesses a genetic predisposition for initially high density.<sup>3</sup> Energy deficiency can also lead to reduced bone formation through pathways that are independent of effects on the ovarian production of oestrogen.<sup>12,13</sup>

DiPietro and Stachenfeld play down the importance of the triad and its specificity to athletes through repeated references to a recent paper by Torstveit and Sundgot-Borgen<sup>14,15</sup> that reported an incidence rate of the female athlete triad in Norwegian athletes that was similar to that observed in their age-matched controls. Although explanations of the methodological errors of this study have been published elsewhere,<sup>16,17</sup> a reiteration of these errors is warranted by DiPietro and Stachenfeld's failure to acknowledge them. The methods of Torstveit and Sundgot-Borgen lead to their underestimation of the incidence of the triad in athletes and the overestimation of its incidence in controls. For example, Torstveit and Sundgot-Borgen<sup>14,15</sup> underestimated energy deficiency by defining disordered

eating as a clinical eating disorder, and not including individuals who inadvertently failed to match energy expenditure with adequate energy intake as the ACSM triad position stand does. Additionally, by failing to diagnose menstrual disturbances by hormone assays and relying instead on self-report, Torstveit and Sundgot-Borgen grossly underestimated the incidence of menstrual disturbances.<sup>18</sup> Furthermore, the prevalence of the simultaneous occurrence of all three components of the triad was undoubtedly biased low in their athletes by their inclusion of "technical" sports that constituted 13 of 66 sports examined. These sports included bowling, curling, billiards, sailing, shooting, sky diving and motorcycle riding. Athletes in these sports, which do not emphasise leanness or aesthetic characteristics, are unlikely to experience triad-related disorders. Meanwhile, the prevalence of all three components in the control group was biased high by their definition of "athletes" as members of national sports teams and "controls" as everyone else, regardless of their activity level. Furthermore, as a result of their failure to differentially diagnose amenorrhoea, four of five controls deemed to have all three components of the triad had body fat percentages >30%, likely indicating pathology related to obesity, and thus an aetiological mechanism different from the undernutrition that underlies the triad. Consideration of the latter point warrants a re-calculation of the prevalence of the simultaneous occurrence of all three components of the triad in the control group as 1/145 or 0.06%, which is about 100-fold lower than that in the athletes from leanness sports (6.6%) in their study.

DiPietro and Stachenfeld suggest that "energy availability does not always seem to be a mechanism" involved in changes in reproductive function among athletes. Citing our own papers,<sup>18</sup> they state that "energy intake was greater in cyclic, ovulating women with menstrual dysfunction than in their sedentary counterparts (suggesting appropriate energy balance and energy availability in these active women)". There are several errors in this statement. Numerous publications clearly establish that exercising women consume more calories than their sedentary counterparts.<sup>19</sup> Thus, it is not surprising that the exercising women in our study consumed more calories than the sedentary women, and it does not imply that our exercising women were in "appropriate energy balance or energy availability" as DiPietro and Stachenfeld state. Indeed, DiPietro and Stachenfeld misrepresent our data by stating that "only anovulatory women in this study had significantly attenuated energy availability". In fact, table 7 of our paper<sup>18</sup> clearly reports that energy availability in all groups of exercising women with varying degrees of menstrual defects was significantly lower than in the sedentary women. Among our subjects,<sup>18</sup> only 21% of the exercising women had ovulatory cycles, whereas the remaining 79% had menstrual disturbances that were clearly linked<sup>20,21</sup> to a disrupted metabolic environment that is characteristic of energy deficiency. Of course, it is no surprise that not all menstrual disturbances in athletes are caused by energy deficiency. Some exercising women, just like some non-exercising women, are subject to endocrinopathies, such as polycystic ovary syndrome, that are extraneous to sports participation. The diagnosis of exercise-related menstrual disturbances must exclude these other pathologies. When proper

diagnostic procedures confirm the existence of exercise-related menstrual disturbances, a significant relationship with energy deficiency is consistently found in both cross-sectional and prospective studies.<sup>20,22,23</sup>

In conclusion, the claims made by DiPietro and Stachenfeld show serious deficits in their understanding of the triad and research related to it. They also show a totally unjustified anxiety about the thoughtful and responsible efforts of ACSM to protect and improve the health and safety, and thereby to promote the increasing participation, of women and girls in sport.

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doi: 10.1136/bjsm.2006.031070

Competing interests: None declared.

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## BOOK REVIEW

### Human rights in youth sport

Edited by P David. London: Published by Routledge, 2005, £70.00 (soft cover), pp 338. ISBN 0415305594

It may not be apparent unless one works in the field, but abuse of athletic children in the name of their sports is relatively widespread, even in so-called civilised societies. It includes the imposition of training regimes suited for adult athletes, punishment, encouraging the development of eating disorders and doping, psychological, sexual and emotional abuse from parents and coaches (who should be the protectors of the child athlete), and other competitors (who might be subjected to the same abuse). It culminates in trafficking and sale of young athletes, and in systematic violation of educational agreements and basic family rights of these children. All this despite the precise statements made by the United Nations Convention on the Rights of the Child. Unfortunately, there are few reliable data on this topic, and Paulo David estimates that, of all children involved in competitive sports, 10% have undergone human rights abuse, and another 20% are at risk.

The author makes the point that self-monitoring in sports is practically non-existent: sport is considered to be a private activity, and it has been recognised only in the past few years that young athletes have special requirements. Also, child labour and exploitation laws do not apply to sports.

The United Nations Convention on the Rights of the Child was not conceived to apply to competitive children's sports, but it is scary to see how essentially all of its articles can and have been circumvented in the name of elite youth sports achievements. It is evident that the education of young elite athletes has to be put on the shelf, possibly never to be taken up again, if a young athlete trains twice a day for up to 30 h